PHILIPS

Perspective on Manufacturing the L Prize® Award Winning LED Bulb

2012 DOE Solid-State Lighting Manufacturing R&D Workshop

June 13, 2012

PHILIPS

L Prize® Winning LED Lamp Production

- Production of L Prize® Winning LED Lamp started Q1
- Assembled in USA - Philips strategic EMS partner in Wisconsin
- Production rates to support at least 250k lamps/year

PHILIPS

L Prize® Winning LED Lamp: Perspective on Manufacturing

- Comparison to traditional glass lamp production methods
- Comparison to traditional electronic product assembly & test methods

PHILIPS

Manufacturing Comparison: L Prize® Winning LED Lamp vs Glass Lamps

- **Traditional Glass Lamps:**
  - After many decades of production, traditional glass lamp production is highly refined and automated.
  - Process & Equipment are designed specifically to convert raw materials into a finished lamp
  - Testing is essentially a Functional light-up of the lamp

- **L Prize® Winning LED Lamp:**
  - This LED lamp combines state of the art designs & electronic components that are assembled into a new product that essentially replaces a single electrical resistor
  - PCB assembly processes use generic Process & Equipment, while LED lamp-specific assembly Process & Equipment are put into cells that are adaptable to future design improvements
  - Testing includes:
    - ICT of driver PCBA,
    - burn-in of the completed LED lamp, and
    - measurements of the light quality of the completed LED lamp

PHILIPS

Manufacturing Comparison: L Prize® Winning LED Lamp vs Electronics Assembly

- **Traditional Electronics Assembly:**
  - Decades of development of SMT & PTH production processes & components
  - Final assembly of PCBAs into metal/plastic housings
  - Product Testing is measuring electrical parameters related to product function (ICT/FCT)
  - PCBA repairs are well defined within electronics industry

- **L Prize® Winning LED Lamp:**
  - LED driver PCBA uses traditional SMD & PTH power components in a high density design
  - The L2 PCBA solders evolving LED components onto non-traditional PCB substrates
  - Final assembly for LED lamp includes soldering an Edison base (circa 1909)
  - Product Testing LED lamps is based on light quality measurements.
    - Uses different testing parameters such as CRI, lumens, color temperature, efficacy, etc.
  - Repairs of individual LEDs not yet defined by industry

PHILIPS

L Prize® Winning LED Lamp – Key Processes

- PCB Assembly (PTH & SMT):
  - Design Rules & DFM guidelines are essential for lowest mfg cost
- LED Binning
  - Defined by Design Engineering
  - Executed by Planning & Manufacturing
- Mechanical Assembly
  - Special Tools and Fixtures required
- Burn-In
- Light Quality Testing
  - Defined by Product Management & Design Engineering
  - Executed by product-specific Test equipment
- Packing

PHILIPS

Experience the L Prize® Award Winning LED Bulb

High Quality Light With More Lumens, Longer Life, and Less Energy

- Be a sustainable lighting leader and be the first to use the most efficient 60W replacement LED lamp.
- Available February 2012
- Assembled in USA


PHILIPS